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INTERRELATION OF M_1 CHLOROPHYLL DEFICIENT SECTORS AND M_2 CHLOROPHYLL MUTATIONS IN RICE

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Chlorophyll deficient sectors on M_1 plants were reported by several investigators in a number of crop species. Chemical mutagens are known to be more effective than radiations in inducing sectors. It is probable that sector formation is correlated to gene mutations. The value of sectors or leaf spots in studies of mutagenic action has increased since the relationship between leaf spots in the M, and chlorophyll mutations in the M_2 was demonstrated by Blixt and Gelin 1965 in peas. The present study was undertaken to ascertain the possibility of using sector frequency as a reliable estimate of mutagenic effects and to correlate the M_1 sectors with M_2 mutations in rice.

Materials and Methods

Seeds of the rice variety Co.29 were treated with fast neutrons, ethyl methane sulphonate (EMS) and nitroso methyl urea (NMH) over a wide range of doses. The M_1 plants at various stages of growth were examined to spot out chlorophyll deficient sectors. The type, intensity and persistance of sectors were studied in the chlorophyll deficient chimeras. The tillers on chimeric plants were marked separately. Panicles on chimeric and normal tillers were labelled. Ears were harvested and sown separately. Chlorophyll mutations in the M_2 germination were scored on M_1 ear progeny basis. Seedlings from striped spikelets were separately scored.

Results and Discussion

The frequencies of plants with chlorophyll deficient sectors presented in Table 1 indicate that chemical mutagens induce more sectors than fast neutrons. The frequencies were generally higher in treatment with NMH than with EMS, indicating that NMH was more effective than EMS in this respect. An increased effectiveness of NMH over EMS in inducing chlorophyll deficient sectors was reported by swaminathan *et al.* (1968) in barley and Prasad (1968) in wheat. The sector frequency increased progressively with increasing doses of chemical mutagens.

The M_1 chimeras showed wide variation with respect to the distribution of chlorophyll deficient sectors. One or more tillers of a plant possessed deficient sectors. The sectors were always longitudinal having white, yellow, yellow green or light green colours. They were more prominant on the leaf blade than on the leaf sheath and culm. The number and width of sectors differed from tiller to tiller on a plant and also from leaf to leaf on a tiller. There were severai narrow sectors or a few broad ones on each leaf. They appeared in the seedling stage or later. The sectors either faded off or increased in size in later leaves. In fast neutron treatment, the sectors were restricted to the first few leaves represented by leaf meristems in the embryo. In those induced by NMH and EMS, the sectors in most cases persisted to the last leaf. The intensity of striping in certain chimeras was very high such that the boot leaves were highly deficient in chlorophyll. In a few cases, the sectors extended into the panicles.

Tabie 1 Frequency of chlorophyll deficient chimeras in the M_1 generation

Mutagen and dose	Number of M_1 plants scored	No. of chlorophyll deficient chimeras	% of chimeras	Mutagen and dose	Number of M_1 plants scored	No. of chlorophyll deficient chimeras	% of chimeras
1) *Fsst nuetrons*							
Control	291	0	0	154 m M	305	8	2.62
705 *tad*	290	0	0	192 m M	306	5	1.63
968 rad	281	2	0.71	240 m M	304	8	2.63
1170 rad	282	1	0.35	288 m M	298	6	2.01
1408 rad	285	2	0.70	336 m M	291	8	2.73
1570 rad	279	0	0	384 m M	287	10	3.48
1710 rad	280	2	0.71	3) *NMH*			
1880 rad	282	2	0.71				
2100 rad	277	2	0.72	Control	350	0	0
2) *EMS*				0.97 m M	343	5	1.46
				1.94 m M	259	11	4.25
Control	355	0	0	2.91 m M	169	6	3.55
19 m M	347	0	0	3.88 m M	157	10	6.37
38 m M	319	0	0	4.85 m M	138	13	9.42
58 m M	319	1	0.31	5,82 m M	114	7	6.14
77 m M	320	2	0.63	7.76 m M	69	7	10.15
96 *m* M	317	2	0.63	9.70 m M	35	7	20.00
115 m M	307	6	1.95				

The inheritance of M_1 chlorophyll deficiency was studied in the M_2 generation. Results are presented in Table 2. Sections 1 and 2 of the table indicate that chlorophyll mutation frequency of chimeric tillers is 2 to 3 times that

Table 2 M_1 chlorophyll deficient chimeras and M_2 chlorophyll mutations

Particulars	Fastneu-trons	EMS	NMH	Total
1. Ear progenies of normal tillers from chimeric plants				
i. Number scored	20.0	56.0	120.0	196.0
ii. Number segregating	2.0	5.0	18.0	25.0
iii. % Segregating	10.0	9.1	15.0	12.8
2. Ear progenies of chimeric tillers from chimeric plants				
i No. scored	9.0	52.0	81.0	142.0
ii. No. Segregating	2.0	14.0	25.0	41.0
iii. % Segregating	22.2	26.9	30.9	28.9
3. Chimeric tillers and striped panicles.				
i. No. of chimeric tillers	9.0	52.0	83.0	142 0
ii. No, of chimeric tillers producing striped panicles	3.0	5.0	15.0	23.0
iii. % of chimeric tillers producing striped panicles	33.3	9.6	18.5	16.2
4. Progenies of normal panicles on chimeric tillers.				
i. No. scored	6.0	47.0	66,0	119.0
ii. No. segregating	2.0	13.0	12.0	27.0
iii. % segregating	33.3	27.7	18.2	22.T
5. Progenies of striped panicles on chimeric tillers.				
i. No. scored	M	5.0	15.0	23.0
ii. No. segregating	0.0	1.0	13.0	14.0
iii. % segregating	0.0	20.0	86.7	60.9
6. Seedlings of normal spikelets on striped panicles.				
i. No. scored	3.0	5.0	3.0	11.0
ii. No. of mutants	0.0	1.0	2.0	3.0
iii. % of mutants	0.0	20.0	66.7	27.3
7. Seedlings of striped spikelets on striped panicles.				
i. No. scored	3.0	5.0	15.0	23.0
ii. No- of mutants	0.0	O.0	13.0	13.0
iii. % of mutants	0.0	0.0	86.7	56.5

of normal tillers on chimeric plants. This reveals a positive association between M_1 chlorophyll deficient sectors and M_2 chlorophyll mutations. However, only 28.9% of ears from chimeric tillers segregated for mutations indicating that the association was not complete. The chimeric tillers produced striped panicles only in a few cases (Table 2). There were also instance of striped borne on normal tillers. These results indicate that chlorophyll deficient sectors on vegetative plant parts such as culm and leaves and oh reproductive parts such as panicles and spikelets originate quite independently.

Sections 4 and 5 of the Table 2 further indicate that the striped panicles on chimeric tillers yielded more mutations than normal panicles on chimeric tillers. Therefore, when the panicles were striped the possibility for them to contain mutations was high. The striped panicles invariably possessed sectors for striped and normal spikelets. The M_2 seedlings from striped spikelets yielded chlorophyll mutants more frequently than those from the normal spikelets (Tables 2—6 and 7).

Two distinctly different patterns of striping were observed on the spikelets. (1) The ridges of lemma and palea were green whereas the sides of the glumes were white. This was the pattern of striping in striped spikelets on chimeric tillers. (2) The ridges of lemma and palea were white whereas the sides of the glumes were green. This was the pattern of striping in striped spikelets on normal tillers. Such spikelets were highly sterile.

The pattern of striping on the spikelets and mutations in the progeny appear to be strongly associated. Striped spikelets of the first type (white on sides) segregated for chlorophyll mutants whereas those of the second type (green on sides) always gave albino seedlings. These results therefore reveal That the "green on sides" type of striping on the spikelets is an indication of albinism in the embryos of seeds,

Goud (1965), Varughese and Swaminathan (1968) and Rao and Washington (1970) reported that chlorophyll chimeras never bread true. According to D'Amato *et al.* (1962) the sectors on leaves orginate through somatic mutations as periclinal chimeras, probably in the outer LI layer and since the germinal tissue develops from the inner LII layer, the mutations might not pass on to the progeny. Siddiq (1967) found the induced chlorophyll deformation in rice to be nonheritable and indicated the possibility of their being either periclinal chimeras or arising from a physiological disorder. In the present investigation, the chimeric tillers yielded mutations in their progeny more frequently than non-chimeric tillers. It was also observed that chlorophyll deficient sectors on leaves and panicles originate independently. Striped panicles yield mutants more frequently than normal panicles on chimeric tillers. Thus it is evident that sectors on the panicles and spikelets give a surer indication of mutations in the M_2 than the sectors on leaves. It may therefore be possible to use sector frequency particularly on the panicle as a reliable estimate of mutagenic effects and to realise a high frequency of chlorophyll mutations in the M_2 generation by selecting M_1 panicles with chlorophyll deficient sectors.

Summary

Studies were undertaken to correlate the M_1 chlorophyll deficient sectors with M_2 chlorophyll mutations in rice. Chemical mutagens induced more sectors than fast neutrons. NMH was more effective than EMS in this respect. The sectors exhibited wide variation in type, intensity and persistance. They originate in leaves and panicles quite independantly. Chimeric tillers yielded more chlorophyll mutations than non-chimeric tillers. Striped panicles produced more mutants than normal panicles. Thus, sectors on panicles and spikelets give a surer indication of mutations in the M_2 than sectors on leaves. The sector frequency on panicles can therefore be used as a reliable estimate of mutagenic effects. Selection of M_1 panicles with sectors can enhance the rate of chlorophyll mutations in the M_2 generation.

സംഗ്രഹം

M_1 നെൽ ചെടികളിൽ raocrugo$n_iiVlajriraRHd3b6ijoooപാതുവായും, NMH പ്രത്യേകമായും കൂടിയ അളവിൽ പർണ്ണഹരിതശൂന്യമേഖലകൾ സൃഷ്ടിക്കുന്നതായി കണ്ടു. ഇലകളിലും കതിരുകളിലും മേഖലകൾ സ്വതന്ത്രമായി ആവിർഭവിക്കുന്നു. ഇത്തരം ചിനപ്പുകൾ മററുള്ളവയേക്കാൾ കൂടിയ അളവിൽ ഉൽപരിവർത്തിതങ്ങളെ പ്രദാനം ചെയ്യുന്നു. ക roil raits! പർണ്ണരഹിതശൂന്യമേഖലകൾ കടന്നു കൂടുമ്പോൾ വളരെ കൂടിയ അളവിൽ ഉൽപരിവർത്തിതങ്ങൾ ആവിർഭവിക്കുന്നു. rawroilcncrai കതിരിലും നെന്മണിയിലും പ്രത്യക്ഷപ്പെടുന്ന വരകൾ പർണ്ണരഹിതശൂന്യ ഉൽപരിവർത്തിതങ്ങളുടെ മുന്നോടിയാണെന്ന് അനുമാനിക്കുകയും വരകളുടെ ആവൃത്തി ഉൽപരിവർത്തക പ്രവർത്തനത്തിന്റെ വിശ്വാസയോഗ്യമായ മാനദണ്ഡമായി സ്വീകരിക്കുകയും ചെയ്യാം. M_1 ൽ ഇത്തരം ചെടികളെ തിരഞ്ഞെടുക്കുന്നതു വഴി അടുത്ത തലമുറയിലെ ഉൽപരിവർതത rar^tyimrnl ഗണ്യമായി വർദ്ധിപ്പിക്കാവുന്നതാണ്.

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